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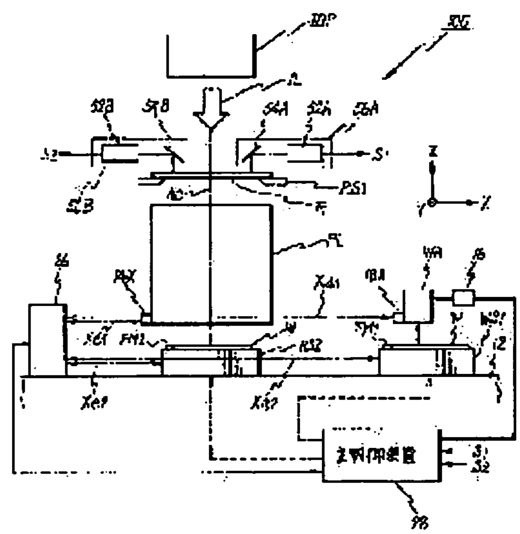
(54) LIGHT-EXPOSURE DEVICE AND LIGHT-EXPOSURE METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a light-exposure method capable of enhancing the throughput and deciding the size of a substrate stage irrespective of a base line amount.



SOLUTION: For example, while a pattern image of a mask R is exposed to lights via a projection optical system PL on a substrate W held by a stage WS2, a location relations between a positioning mark on the substrate W held by a stage WS1 and a reference point on the stage WS1 is measured. After the substrate W held by the stage WS2 is completed being exposed to lights, under a state that a reference point on the stage WS1 is positioned in a projection region of the projection optical system PL, location deviations of the reference point on the stage WS1 with respect to a specific reference point in the projection region and a coordinate location of the stage WS1 at the time of detecting the location deviations are detected. Thereafter, movements of the stage WS1 are controlled based on the detection results, and the substrate W held by the stage WS1 is positioned to the pattern image of the mask R.

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CLAIMS

[Claim(s)]
[Claim 1] It is the exposure approach which exposes the image of the pattern formed in the mask on an induction substrate through projection optics. Hold an induction substrate and two independently movable substrate stages are respectively prepared for the inside of the same flat surface. The pattern image of said mask is exposed through said projection optics on the induction substrate held on one substrate stage of said two substrate stages. During exposure of the induction substrate held on one [said] substrate stage, the physical relationship of the alignment mark on the induction substrate held on the substrate stage of another side of said two substrate stages and the reference point on the stage of said another side is measured. After exposure termination of the induction substrate held on one [said] substrate stage, the reference point on the substrate stage of said another side in the condition of having positioned in the projection field of said projection optics The coordinate location of a location gap of the origin/datum on the substrate stage of said another side to the predetermined origin/datum in the projection field and the substrate stage of said another side is detected. The exposure approach characterized by performing alignment of the induction substrate which controlled migration of the substrate stage of said another side based on said detected physical relationship, said detected location gap, and said detected coordinate location, and was held on the stage of said another side, and the pattern image of said mask.
[Claim 2] It is the aligner which exposes a pattern on an induction substrate through projection optics. Said projection optics is established independently. an induction substrate -- holding -- the inside of a two-dimensional flat surface -- the movable 1st substrate stage and; induction substrate -- holding -- the inside of the same flat surface as said 1st substrate stage -- said 1st substrate stage -- the independently movable 2nd substrate stage and; -- Interferometer systems for measuring the two-dimensional location of the alignment system for detecting the mark on the induction substrate held on said substrate stage or on this stage, the 1st substrate stage of; above, and the 2nd substrate stage, respectively; each of said two substrate stages The 1st predetermined location in the stage successive range at the time of the exposure to which exposure is performed through said projection optics to the induction substrate held on this stage, By said alignment system On a stage Or the migration means to which it is made to move between the 2nd predetermined location in the stage successive range at the time of the alignment to which mark detection on the induction substrate held on this stage is carried out; while the induction substrate held on one stage of said 1st substrate stage and the 2nd substrate stages is exposed So that mark detection actuation by said alignment system may be performed on the stage of another side of said 1st substrate stage and the 2nd substrate stages The aligner which has the control means which controls said migration means and replaces the location of one [said] substrate stage and the substrate stage of another side after controlling actuation of said two stages, carrying out the monitor of the measurement value of said interferometer systems.
[Claim 3] It is the aligner according to claim 1 characterized by to equip said interferometer systems with the 1st length measurement shaft and the 2nd length measurement shaft which cross at right angles to mutual focusing on projection of said projection optics, and the 3rd length measurement shaft and the 4th length measurement shaft which cross at right angles to mutual focusing on detection of said alignment system, and to reset the length-measurement shaft of said interferometer systems in case said control means replaces the location of the stage of said one side and another side.

[Claim 4] It is the aligner which exposes a pattern on an induction substrate through projection optics. Said projection optics is established independently. an induction substrate -- holding -- the inside of a two-dimensional flat surface -- the movable 1st substrate stage and; induction substrate -- holding -- the inside of the same flat surface as said 1st substrate stage -- said 1st substrate stage -- the independently movable 2nd substrate stage and; -- Interferometer systems for measuring the two-dimensional location of the alignment system for detecting the mark on the induction substrate held on said substrate stage or on this stage, the 1st substrate stage of; above, and the 2nd substrate stage, respectively; each of said two substrate stages The 1st predetermined location in the stage successive range at the time of the exposure to which exposure is performed through said projection optics to the induction substrate held on the stage, The 2nd predetermined location in the stage successive range at the time of the alignment to which mark detection on the induction substrate held by said alignment system on a stage or on this stage is carried out, The migration means to which delivery of an induction substrate is carried out between a substrate stage and an external substrate conveyance device, and it is made to move among 3 points of the 3rd location of ****; The location of one stage of said 1st substrate stage and the 2nd substrate stages is managed by said interferometer systems. While a pattern is exposed through said projection optics by the induction substrate held on one [this] stage Said 1st substrate stage And the alignment actuation which measures the physical relationship of exchange of an induction substrate and the alignment mark on said induction substrate, and the reference point on the stage of said another side based on the detection result of said alignment system and the measurement value of said interferometer systems on the stage of another side of the 2nd substrate stages While controlling said two substrate stages and said migration means to be carried out one by one The aligner which has the control means which controls said two stages and said migration means so that the actuation performed on said two stages may interchange, after both actuation of said two stages is completed.
[Claim 5] The aligner according to claim 4 with which the image of the pattern which has further the mask with which the pattern was formed and was formed in said mask is characterized by carrying out projection exposure at the induction substrate on said 1st substrate stage and the 2nd substrate stage through projection optics.
[Claim 6] The 1st length measurement shaft and the 2nd length measurement shaft with which said interferometer systems cross at right angles to mutual focusing on projection of said projection optics, It has the 3rd length measurement shaft and the 4th length measurement shaft which cross at right angles to mutual focusing on detection of said alignment system. Said control means The aligner according to claim 5 characterized by resetting the 1st and 2nd length measurement shaft of said interferometer systems in the case of migration in said 1st location, and resetting the 3rd and 4th length measurement shaft of said interferometer systems about each of said two stages in the case of migration in said 2nd location.
[Claim 7] The aligner according to claim 6 characterized by having further a mark location detection means to detect the relative-position relation between the projection core of the pattern image of said mask, and the reference point on said stage through said mask and said projection optics.
[Claim 8] It has the substrate attachment component which said each substrate stage is carried free [attachment and detachment] on a stage body and this body, and holds a substrate. The reflector for interferometers is established in the side face of this substrate attachment component, and a reference mark is formed in the top face of said substrate attachment component as said reference point. An aligner given in claim 2 to which said migration means is characterized by moving said substrate attachment component between said every place points instead of said substrate stage thru/or any 1 term of 7.
[Claim 9] Said migration means is an aligner given in claim 2 characterized by being constituted by the robot arm thru/or any 1 term of 8.
[Claim 10] An aligner given in claim 2 characterized by attaching in said projection optics and said alignment system the fixed mirror which serves as criteria of length measurement by the interferometer, respectively thru/or any 1 term of 9.
[Claim 11] It is an aligner given in claim 2 characterized by holding the induction substrate other than said 1st substrate stage and the 2nd substrate stage, and these stages having further at least one another, independently movable substrate stage for the inside of said two same flat surfaces as a substrate stage thru/or any 1 term of 10.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the exposure approach and an aligner, and relates to aligners, such as drawing equipment which carries out direct writing of the pattern on an induction substrate by the charged-particle line of a laser beam, and an electron ray and others etc., for manufactures, such as the exposure approach which exposes the mask pattern used in more detail in case a semiconductor device, a liquid crystal display component, etc. are manufactured at a lithography process on an induction substrate through projection optics and an aligner or a semiconductor device, and a mask for semiconductor device manufacture. This invention has the description at the point of having two or more substrate stages holding an induction substrate.
[0002]
[Description of the Prior Art] Although various aligners are conventionally used when manufacturing a semiconductor device or a liquid crystal display component at a photolithography process In current, a photo mask or the pattern image of a reticle (it is hereafter named a "reticle" generically) Generally the projection aligner imprinted on substrates (an "induction substrate" or a "wafer" is called suitably hereafter), such as a wafer with which sensitization material, such as a photoresist, was applied to the front face through projection optics, or a glass plate, is used. The so-called contraction projection aligner (the so-called stepper) of the step-and-repeat method which lays an induction substrate on a freely movable substrate stage two-dimensional, is made to carry out stepping (stepping) of the induction substrate by this substrate stage as this projection aligner in recent years, and repeats the actuation which carries out sequential exposure of the pattern image of a reticle to each shot field on an induction substrate is in use.
[0003] Comparatively many projection aligners (for example, scanning aligner which was indicated by JP,7-176468,A) of step - which added amelioration to quiescence mold aligners, such as this stepper, and - scanning method have also recently come to be used. It has the equalization effectiveness by carrying out the relative scan of a reticle and the wafer to ** projection optics which can expect a high throughput by reduction of the shots per hour by large field exposure, and has a merit with the expectable improvement in distortion or the depth of focus while manufacture of projection optics is easy for it, since the projection aligner of this step - and - scanning method can expose the large field by smaller optical system compared with ** stepper.
[0004] In this kind of projection aligner, it is necessary to perform alignment (alignment) of a reticle and a wafer with high precision in advance of exposure. In order to perform this alignment, on the wafer, the mark for location detection (alignment mark) formed at the former photolithography process (exposure imprint) is prepared, and the exact location of a wafer (or circuit pattern on a wafer) can be detected by detecting the location of this alignment mark.
[0005] Although there is a thing of the on-axis method which divides roughly and performs mark detection through a projection lens as an alignment microscope which detects an alignment mark, and the off axis method which performs mark detection without a projection lens, in the projection aligner

using the excimer laser which will become the future mainstream, the alignment microscope of an off axis method is the optimal. Since amendment of chromatic aberration is made to exposure light, this a projection lens As opposed to the error by chromatic aberration becoming very big, even if in the case of an on-axis it cannot condense alignment light or is able to condense the alignment microscope of an off axis method It is because a free optical design's being possible and various alignment systems can be used, without taking such chromatic aberration into consideration, since it is prepared apart from the projection lens. For example, a phase-contrast microscope, a differential interference microscope, etc. can be used.
[0006] By the way, the flow of the processing in this kind of projection aligner has become like size Yoji.
[0007] ** The wafer load process which loads a wafer on a wafer table using a wafer loader is performed first, and the so-called search alignment is performed by being based on a wafer appearance subsequently etc.
[0008] ** Next, the fine alignment process which asks for the location of each shot field on a wafer correctly is performed. Generally as for this fine alignment process, an EGA (en hunger strike global alignment) method is used. This method Choose two or more sample shots in a wafer, and sequential measurement of the location of the alignment mark (wafer mark) attached to the sample shot concerned is carried out. Based on this measurement result and the design value of a shot array, the statistics operation by the so-called least square method etc. is performed. It can ask for all the shot array data on a wafer, and can ask for the coordinate location of each shot field comparatively with high precision by the high throughput (reference, such as JP,61-44429,A).
[0009] ** Next, the exposure process which imprints the pattern image of a reticle on a wafer through projection optics is performed, carrying out sequential positioning of each shot field on a wafer in an exposure location based on the coordinate location of each shot field for which it asked with the EGA method mentioned above, and the amount of base lines measured beforehand.
[0010] ** Next, the wafer unload process to which the unload of the wafer on the wafer table by which exposure processing was carried out is carried out using a wafer unloader is performed. This wafer unload process is performed to the wafer load process and coincidence of the above-mentioned **. That is, a wafer exchange process is constituted by ** and **.
[0011] thus -- the conventional projection aligner -- wafer exchange (search alignment is included) -> fine alignment -> exposure -> wafer exchange -- like ...., three actuation is greatly performed repeatedly using one wafer stage.
[0012]
[Problem(s) to be Solved by the Invention] It is requested inevitably that the throughput, i.e., a throughput, whether it can carry out exposure processing of the wafer of the number of sheets of which in fixed time amount since the projection aligner mentioned above is used mainly as mass-production machines, such as a semiconductor device, should be raised.
[0013] Although it is necessary about this to shorten the time amount which each actuation takes from three actuation mentioned above being performed sequentially with the present projection aligner for the improvement in a throughput, since 1 actuation is only performed to one wafer, the wafer exchange (search alignment is included) of the effectiveness of an improvement is comparatively small. Moreover, in case the EGA method mentioned above is used for the time amount which fine alignment takes, it can be shortened by lessening the number of samplings of a shot or shortening the measurement time amount of a shot simple substance, but since alignment precision is made to deteriorate on the contrary, these things cannot shorten the time amount which fine alignment takes easily.
[0014] Therefore, although it will be said that it is the most effective in order for it to be improvement in a throughput to shorten conclusively the time amount which exposure takes Although the pure wafer exposure time and the stage stepping time between shots are included in this exposure actuation in the case of the stepper and it becomes indispensable that the quantity of light of the light source is large at compaction of the wafer exposure time In this kind of projection aligner, as important conditions besides the above-mentioned throughput side There are resolution, ** depth of focus (DOF:Depth of Forcus), **

line breadth control precision, etc. ** Resolution R When exposure wavelength is set to lambda and numerical aperture of a projection lens is made into N.A. (Numerical Aperture), it is proportional to lambda/N.A., and the depth of focus DOF is lambda/2 (N.A.). It is proportional. For this reason, it is the bright line (g lines) of the extra-high pressure mercury lamp which it is required for wavelength to be also short as the light source, and was used conventionally. It is said that the excimer laser previously described as what satisfies the requirements for both that power is large compared with i line etc., and it is short wavelength becomes the future mainstream, wavelength is shorter than this, the quantity of light is large, and the light source suitable as the light source of an aligner is not considered at a present stage. Therefore, when using excimer laser as the light source, the improvement in the above throughput can seldom be expected, but there is a limitation also in improvement in the throughput by the device of the light source.

[0015] On the other hand, the improvement in full speed and the highest acceleration having un-arranged [of being easy to cause degradation of the positioning accuracy of a stage], although the full speed of the stage holding a wafer and the highest acceleration needed to be raised for compaction of the stage stepping time between shots. In addition, although compaction of the exposure time of a wafer is possible for the case of a scanning projection aligner like step - and - scanning method by gathering the relative scan speed of a reticle and a wafer, since the improvement in a relative scan speed tends to cause degradation of synchronous precision, a scan speed cannot be gathered easily. Therefore, it is necessary to raise the controllability of a stage.

[0016] However, it is not easy to raise the controllability of a stage with the equipment using an off-axis alignment microscope like the projection aligner using the excimer laser which will become the mainstream especially from now on. At namely, the time of exposure of the mask pattern which minds projection optics in this kind of projection aligner In order to manage the location of a wafer stage correctly without an Abbe error in both times of alignment and to realize highly precise superposition It is necessary to set up so that the length measurement shaft of a laser interferometer may pass along the projection core of projection optics, and the detection core of an alignment microscope, respectively. And since it is necessary to make it both the length measurement shaft which passes along the projection core of said projection optics by both with the inside of the successive range of the stage at the time of alignment in the successive range of the stage at the time of exposure, and the length measurement shaft passing through the detection core of an alignment microscope not go out, It is because a stage is enlarged inevitably.

[0017] As mentioned above, by the technique of shortening the time amount which each actuation of three actuation mentioned above takes, it is difficult to raise a throughput without any demerit, and looked forward to the appearance of the new technique which raises a throughput by technique different from this.

[0018] This invention was made under this situation, and the purpose of invention according to claim 1 is to offer the exposure approach that the magnitude of a substrate stage can be defined regardless of the amount of base lines while being able to raise a throughput.

[0019] Moreover, claim 2 thru/or the purpose of invention given in 11 are to offer the aligner which can raise a throughput.

[0020]

[Means for Solving the Problem] If three actuation mentioned above, i.e., wafer exchange, (search alignment is included), fine alignment, and two or more actuation of the exposure actuation can be processed in [that it is also partial] concurrency, it will be thought compared with the case where these actuation is performed sequentially that a throughput can be raised. This invention was made paying attention to this viewpoint, and following approaches and configurations are used for it. Namely, invention according to claim 1 is the exposure approach which exposes the image of the pattern formed in the mask (R) on an induction substrate (W) through projection optics (PL). An induction substrate (W) is held. Prepare two independently movable substrate stages (WS1, WS2) for the inside of the same flat surface respectively, and said projection optics (PL) is minded on; induction substrate (W) held on one substrate stage (WS1 or WS2) of said two substrate stages (WS1, WS2). During exposure of the

induction substrate (W) which exposed the pattern image of said mask (R) and was held on; aforementioned one substrate stage (WS1 or WS2) After exposure termination of the induction substrate which measured the physical relationship of the alignment mark on the induction substrate (W) held on the substrate stage (WS2 or WS1) of another side of said two substrate stages, and the origin/datum on the stage (WS2 or WS1) of said another side, and was held on; aforementioned one substrate stage In the condition of having positioned in the projection field of said projection optics (PL), the reference point on the substrate stage of said another side The physical relationship by which detected the coordinate location of a location gap of the origin/datum on the substrate stage of said another side to the predetermined origin/datum in the projection field, and the substrate stage of said another side, and the; aforementioned detection was carried out, Based on said detected location gap and said detected coordinate location, migration of the substrate stage of said another side is controlled, and it is characterized by performing alignment of the induction substrate held on the stage of said another side, and the pattern image of said mask.

[0021] While exposure of the pattern image of said mask (R) is performed through said projection optics (PL) on the induction substrate (W) held on one substrate stage (WS1 or WS2) of the two substrate stages (WS1, WS2) according to this ** The physical relationship of the alignment mark on the induction substrate (W) held on the substrate stage (WS2 or WS1) of another side of the two substrate stages and the reference point on the stage (WS2 or WS1) of another side is measured. Thus, since exposure actuation by the side of one substrate stage and alignment actuation by the side of the substrate stage of another side (measurement of the physical relationship of the alignment mark on the induction substrate held on the substrate stage of another side and the reference point on the stage of another side) can be performed in parallel, it is possible to aim at improvement in a throughput compared with the conventional technique in which these actuation was performed sequentially.

[0022] and the condition positioned the reference point on the substrate stage (WS2 or WS1) of said another side in the projection field of projection optics (PL) after exposure termination of the induction substrate held on one above-mentioned substrate stage -- ** -- a location gap and ** of the reference point on the substrate stage of another side to the predetermined reference point in the projection field -- the coordinate location of the substrate stage of another side at the time of the location gap detection is detected. Based on the physical relationship of which ** detection was done, the location gap of which ** detection was done, and the coordinate location of which ** detection was done, migration of the substrate stage (WS2 or WS1) of another side is controlled after that, and alignment of the induction substrate held on the stage of another side and the pattern image of said mask is performed.

[0023] For this reason, the interferometer which manages the location of the substrate stage concerned at the time of physical relationship detection with the predetermined origin/datum on the substrate stage of another side of **, and the alignment mark on an induction substrate (or system of coordinates), ** There is nothing. any [even when the interferometer (or system of coordinates) which manages the location of the stage in the case of location gap detection of ** and detection of the coordinate location of a substrate stage is the same, even if it differs] -- inconvenient -- Alignment of the pattern image of a mask and the induction substrate carried in the substrate stage of said another side can be performed with high precision.

[0024] Therefore, when [for example,] the alignment system of an off axis is used as a mark detection system which detects an alignment mark, The predetermined reference point in the projection field of projection optics (projection core of the pattern image of a mask), and the physical relationship based on [of an alignment system] detection, Namely, since measurement of the amount of base lines becomes unnecessary, and there is no un-arranging even if projection optics and an alignment system are greatly separated as a result The magnitude of a substrate stage can be set up regardless of the amount of base lines, and even if it lightweight[small and]-izes a substrate stage, any pattern which minded mark location measurement and projection optics to the whole surface of an induction substrate can be exposed that there is nothing inconvenient. In this case, it is not influenced by the amount of base lines of fluctuation.

[0025] Invention according to claim 2 is an aligner which exposes a pattern on an induction substrate

(W) through projection optics (PL). Hold an induction substrate (W) and the movable 1st substrate stage (WS1) and; induction substrate (W) are held for the inside of a two-dimensional flat surface. The inside of the same flat surface is independently established in the 2nd substrate stage (WS2) where said 1st substrate stage (WS1) is independently movable, and the; aforementioned projection optics (PL) as said 1st substrate stage (WS1). On said substrate stage (WS1, WS2) Or interferometer systems for measuring the two-dimensional location of the alignment system (WA) for detecting the mark on the induction substrate (W) held on this stage, the 1st substrate stage of; above, and the 2nd substrate stage, respectively (26); each of said two substrate stages The 1st predetermined location in the stage successive range at the time of the exposure to which exposure is performed through said projection optics to the induction substrate held on this stage, By said alignment system On a stage or the migration means (20 --) to which it is made to move between the 2nd predetermined location in the stage successive range at the time of the alignment to which mark detection on the induction substrate held on this stage is carried out While the induction substrate held on one stage of 22), the; 1st substrate stage, and the 2nd substrate stages is exposed So that mark detection actuation by said alignment system (WA) may be performed on the stage of another side of said 1st substrate stage and the 2nd substrate stages After controlling actuation of said two stages, carrying out the monitor of the measurement value of said interferometer systems (26), it has the control means (28) which controls said migration means (20 22) and replaces the location of one [said] substrate stage and the substrate stage of another side.

[0026] While the induction substrate held on one stage is exposed by the control means (28) according to this, so that mark detection actuation by the alignment system (WA) may be performed on the stage of another side After actuation of two stages is controlled carrying out the monitor of the measurement value of interferometer systems (26), a migration means (20 22) is controlled and exchange of the location of one substrate stage and the substrate stage of another side is performed. For this reason, by parallel processing of the exposure actuation by the side of one substrate stage, and the alignment actuation by the side of the stage of another side, while improvement in a throughput is possible If it is made to exchange an induction substrate on the substrate stage located after exchange of a location in the 2nd location Actuation of both stages is replaced, and while the induction substrate held on the stage of another side is exposed, it becomes possible to perform mark detection actuation by the alignment system (WA) in parallel on one stage.

[0027] Invention according to claim 3 is set to an aligner according to claim 2. Said interferometer systems (26) The 1st length measurement shaft (Xe) and the 2nd length measurement shaft (Ye) which cross at right angles to mutual focusing on projection of said projection optics (PL), It has the 3rd length measurement shaft (Xa) and the 4th length measurement shaft (Ya) which cross at right angles to mutual focusing on detection of said alignment system (WA). Said control means (28) In case the location of the stage of said one side and another side is replaced, it is characterized by resetting the length measurement shaft (Xe, Ye, Xa, Ya) of said interferometer systems (26).

[0028] The 1st length measurement shaft (Xe) and the 2nd length measurement shaft (Ye) with which interferometer systems (26) cross at right angles to mutual focusing on projection of projection optics (PL) according to this, From having the 3rd length measurement shaft (Xa) and the 4th length measurement shaft (Ya) which cross at right angles to mutual focusing on detection of an alignment system (WA) The location of a substrate stage (WS1, WS2) is correctly manageable without the error of ABBE at the time of any at the time of exposure of the pattern to the induction substrate top through projection optics, and detection of the location detection mark by the alignment system. Moreover, in case a control means (28) replaces the location of the stage of one side and another side Since the length measurement shaft (Xe, Ye, Xa, Ya) of interferometer systems (26) is reset, even if the length measurement shaft of the interferometer systems which had managed the location of each substrate stage till then on the occasion of exchange of a location once goes out If the location which resets the length measurement shaft (Xe, Ye, Xa, Ya) of interferometer systems (26) is beforehand set to the position, it will become possible after reset to manage the location of the 1st and 2nd substrate stage using the measurement value of the reset length measurement shaft.

[0029] Invention according to claim 4 is an aligner which exposes a pattern on an induction substrate

(W) through projection optics (PL). Hold an induction substrate (W) and the movable 1st substrate stage (WS1) and; induction substrate (W) are held for the inside of a two-dimensional flat surface. Said projection optics (PL) is established independently. the inside of the same flat surface as said 1st substrate stage (WS1) -- said 1st substrate stage -- the independently movable 2nd substrate stage (WS2) and; -- Interferometer systems for measuring the two-dimensional location of the alignment system (WA) for detecting the mark on the induction substrate held on said substrate stage or on this stage, the 1st substrate stage of; above, and the 2nd substrate stage, respectively (26); each of said two substrate stages The 1st predetermined location in the stage successive range at the time of the exposure to which exposure is performed through said projection optics (PL) to the induction substrate (W) held on the stage, The 2nd predetermined location in the stage successive range at the time of the alignment to which mark detection on the induction substrate held by said alignment system (WA) on a stage or on this stage is carried out, The location of one stage of the migration means (20 22) and the; 1st substrate stage (WS1) to which delivery of an induction substrate is performed between a substrate stage and an external substrate conveyance device, and it is made to move among 3 points of the 3rd location of ****, and the 2nd substrate stages (WS2) Said interferometer systems While a pattern is exposed through said projection optics (PL) by the induction substrate (W) which was managed by (26) and held on one [this] stage Said 1st substrate stage On the stage of another side of the 2nd substrate stages, and an induction substrate Exchange of (W) And said induction substrate (W) So that alignment actuation which measures the physical relationship of the upper alignment mark and the reference point on the stage of said another side based on the detection result of said alignment system (WA) and the measurement value of said interferometer systems (26) may be performed one by one While controlling said two substrate stages (WS1, WS2) and said migration means (20 22) After both actuation of said two stages is completed, it has the control means (28) which controls said two stages and said migration means so that the actuation performed on said two stages may interchange.

[0030] According to this, the location of one substrate stage is managed by interferometer systems by the control means. While a pattern is exposed through projection optics by the induction substrate held on one [this] substrate stage On the substrate stage of another side, exchange of an induction substrate (W) And the induction substrate after the exchange (W) So that alignment actuation which measures the physical relationship of the upper alignment mark and the reference point on the stage of another side based on the detection result of an alignment system (WA) and the measurement value of interferometer systems (26) may be performed one by one Two substrate stages (WS1, WS2) and a migration means (20 22) are controlled. For this reason, much more improvement in a throughput is possible by parallel processing with exchange of the induction substrate by the side of the exposure actuation by the side of one substrate stage, and the stage of another side, and alignment actuation. In this case, since exchange of an induction substrate is performed in the 3rd different location from the 1st location and the 2nd location, this exchange can be performed in a location different from an alignment system and projection optics, and there is also no un-arranging [that an alignment system and projection optics become the hindrance of exchange of an induction substrate].

[0031] Moreover, in both control means, after actuation of two stages is completed, so that the actuation performed on two stages may interchange From controlling two stages and migration means, after termination of the two above-mentioned stages of operation this -- then, while the induction substrate held on the stage of another side is exposed, it becomes possible to perform mark detection actuation by the alignment system (WA) in parallel on one stage.

[0032] In this case, although direct writing of the pattern may be carried out with an electron beam on an induction substrate, using for example, an electronic lens-barrel as projection optics The mask (R) with which the pattern was formed like invention according to claim 5 is prepared further. The projection exposure of the image of the pattern formed in said mask (R) may be made to be carried out at the induction substrate (W) on said 1st substrate stage (WS1) and the 2nd substrate stage (WS2) through projection optics (PL).

[0033] Invention according to claim 6 is set to an aligner according to claim 5. Said interferometer systems (26) The 1st length measurement shaft (Xe) and the 2nd length measurement shaft (Ye) which

cross at right angles to mutual focusing on projection of said projection optics (PL), It has the 3rd length measurement shaft (Xa) and the 4th length measurement shaft (Ya) which cross at right angles to mutual focusing on detection of said alignment system (WA). Said control means (28) About each of said two stages (WS1, WS2), the 1st and 2nd length measurement shaft (Xe and Ye) of said interferometer systems (26) is reset in the case of migration in said 1st location. It is characterized by resetting the 3rd and 4th length measurement shaft (Xa and Ya) of said interferometer systems (26) in the case of migration in said 2nd location.

[0034] The 1st length measurement shaft (Xe) and the 2nd length measurement shaft (Ye) with which interferometer systems (26) cross at right angles to mutual focusing on projection of projection optics (PL) according to this, From having the 3rd length measurement shaft (Xa) and the 4th length measurement shaft (Ya) which cross at right angles to mutual focusing on detection of an alignment system (WA) The location of a substrate stage (WS1, WS2) is correctly manageable without the error of ABBE at the time of any at the time of exposure of the pattern to the induction substrate top through projection optics, and detection of the location detection mark by the alignment system. A control means (28) moreover, about each of two stages (WS1, WS2) The 1st and 2nd length measurement shaft (Xe and Ye) of interferometer systems (26) is reset in the case of migration in the 1st location. From resetting the 3rd and 4th length measurement shaft (Xa and Ya) of interferometer systems (26) in the case of migration in the 2nd location The length measurement shaft needed in each actuation before exposure initiation and alignment measurement initiation also about which substrate stage is resettable. Even if the length measurement shaft of the interferometer systems which had managed the location of each substrate stage till then once goes out, it becomes possible after reset to manage the location of both the stages at the time of alignment using the measurement value of the reset length measurement shaft at the time of exposure.

[0035] In this case, it is desirable like invention according to claim 7 to have further a mark location detection means (52A, 52B) to detect the relative-position relation between the projection core of the pattern image of said mask (R) and the reference point on said stage through said mask (R) and said projection optics (PL). In this case, when a substrate stage (WS1, WS2) is positioned in the location where detection of the predetermined origin/datum on a substrate stage (18) and the physical relationship based on [of a mask pattern image] projection is attained in the projection field of projection optics (PL) The physical relationship of the projection core of the pattern image of a mask (R) and the reference point on a substrate stage is detectable through a mask (R) and projection optics (PL) with a mark location detection means (52A, 52B). It is desirable that the location where detection of the predetermined reference point on a substrate stage (18) and the physical relationship based on [of a mask pattern image] projection is attained in the projection field of projection optics (PL) is defined as the 1st location in this case, and it is made to perform reset of the 1st and 2nd length measurement shaft in this location.

[0036] In each above-mentioned invention said each substrate stage (WS1, WS2) like invention according to claim 8 A stage body (WS1a, WS2a), It has the substrate attachment component (WS1b, WS2b) which is carried free [attachment and detachment] on this body (WS1a, WS2a), and holds a substrate. The reflector for interferometers is established in the side face of this substrate attachment component (WS1b, WS2b), and it is a reference mark (it WM(s)) as said reference point in the top face of said substrate attachment component. When RM) is formed, you may make it said migration means (20 22) move said substrate attachment component between said every place points instead of said substrate stage.

[0037] [in these cases] moreover, as a migration means Among 3 points of the 1st location, the 2nd location, and the 3rd location (or between the 1st location and the 2nd location) an interferometer measurement value -- **** for monitors -- as long as it moves a substrate stage or a substrate attachment component without things, what kind of thing may be used, for example, the migration means may be constituted by the robot arm (20 22) like invention according to claim 9.

[0038] Moreover, in each above-mentioned invention, although the fixed mirror used as the criteria of length measurement of interferometer systems may be arranged anywhere, it may attach in said

projection optics (PL) and said alignment system (WA) the fixed mirror (14X, 14Y, 18X, 18Y) which serves as criteria of length measurement by the interferometer, respectively like invention according to claim 10. In this case, compared with the case where a fixed mirror is in other locations, it is hard to produce an error in a length measurement result under the effect of location fluctuation of the fixed mirror resulting from location fluctuation of a fixed mirror with time or vibration of equipment.
[0039] In each above-mentioned invention, although only two, the 1st substrate stage and the 2nd substrate stage, were prepared, like invention according to claim 11, the induction substrate other than said 1st substrate stage (WS1) and the 2nd substrate stage (WS2) may be held, and these stages may prepare further at least one another, independently movable substrate stage for the inside of said two same flat surfaces as a substrate stage.
[0040]
[Embodiment of the Invention]
<< -- 1st operation gestalt>> -- the 1st operation gestalt of this invention is hereafter explained based on drawing 1 thru/or drawing 4 .
[0041] The configuration of the aligner 100 concerning the 1st operation gestalt is shown in drawing 1 . This aligner 100 is a contraction projection mold aligner (the so-called stepper) of a step-and-repeat method.
[0042] The reticle stage RST where this projection aligner 100 holds the reticle R as an illumination system IOP and a mask, The projection optics PL which projects the image of the pattern formed in Reticle R on the wafer W as an induction substrate Wafer W is held. A base 12 top as the movable 1st substrate stage in the secondary XY direction The interferometer systems 26 which hold the ** wafer stage WS 1 and Wafer W, and measure each location of the wafer stages WS1 and WS2 of 2 or 2 wafer stages WS as the movable 2nd substrate stage for a base 12 top in the XY two-dimensional direction independently in the wafer stage WS 1, It has the main control unit 28 grade as a control means which consists of the minicomputer (or microcomputer) constituted including CPU, ROM, RAM, an I/O interface, etc., and carries out generalization control of the whole equipment.
[0043] Said illumination system IOP consists of the light sources (a mercury lamp or excimer laser) and an illumination-light study system which consists of a fly eye lens, a relay lens, a condensing lens, etc. This illumination system IOP illuminates the pattern of the inferior surface of tongue (pattern formation side) of Reticle R by uniform illumination distribution by the illumination light IL for the exposure from the light source. Here, as illumination light IL for exposure, excimer laser light, such as the bright lines, such as i line of a mercury lamp, or KrF, ArF, etc. is used.
[0044] On the reticle stage RST, Reticle R is being fixed through a fixed means by which it does not illustrate, and the minute drive of this reticle stage RST is enabled by the non-illustrated drive system in X shaft orientations (the space rectangular cross direction in drawing 1), Y shaft orientations (space longitudinal direction in drawing 1), and the direction (hand of cut within XY side) of theta. Thereby, this reticle stage RST can position Reticle R now in the condition that the core (reticle center) of the pattern of Reticle R is mostly in agreement with the optical axis Ae of projection optics PL (reticle alignment). The condition that this reticle alignment was performed is shown by drawing 1 .
[0045] Projection optics PL is made into Z shaft orientations to which the migration side of a reticle stage RST and the optical axis Ae cross at right angles, and what is a both-sides tele cent rucksack here, and has the predetermined contraction scale factor beta (beta is 1/5) is used. For this reason, where alignment (alignment) of the pattern of Reticle R and the shot field on Wafer W is performed, if Reticle R is illuminated by the illumination light IL with a uniform illuminance, the pattern of a pattern formation side will be reduced by projection optics PL for the contraction scale factor beta, it will be projected on the wafer W with which the photoresist was applied, and the contraction image of a pattern will be formed in each shot field on Wafer W.
[0046] With this operation gestalt, moreover, in the side face by the side of the X shaft orientations 1 of projection optics PL (left-hand side in drawing 1) X fixed mirror 14X used as the criteria of X shaft-orientations location management at the time of exposure of the wafer stages WS1 and WS2 is fixed. Similarly in the side face by the side of the Y shaft orientations 1 of projection optics PL (space back

side in drawing 1) Y fixed mirror 14Y used as the criteria of Y shaft-orientations location management at the time of exposure of the wafer stages WS1 and WS2 is being fixed (refer to drawing 3).
[0047] The non-illustrated gas hydrostatic bearing is prepared in the base of said wafer stages WS1 and WS2, respectively, and surfacing support of the wafer stages WS1 and WS2 is carried out by these gas hydrostatic bearings through the path clearance of several micron (micrometer) extent in the base 12 upper part, respectively between base 12 top faces. Mirror plane processing is performed to the field by the side of the X shaft orientations 1 of these wafer stages WS1 and WS2 (left-hand side in drawing 1), and the field by the side of the Y shaft orientations 1 (space back side in drawing 1), respectively, and the reflector which functions as a migration mirror for reflecting the length measurement beam from interferometer systems 26 is formed in them, respectively.
[0048] Moreover, the magnet is being fixed to the base of the wafer stages WS1 and WS2, respectively, and, as for the wafer stages WS1 and WS2, it moves in the XY two-dimensional direction in a base 12 top according to the electromagnetic force generated by the drive coil which is not illustrated [which was embedded in the predetermined range in the base (specifically the predetermined field near the projection optics PL lower part and the predetermined field near the alignment microscope WA lower part)]. That is, the so-called MUBINGU magnet type as a driving means of the wafer stages WS1 and WS2 of linear motor is constituted by the magnet of the wafer stage WS 1 and WS2 base, and the drive coil embedded in the base 12. The drive current of the drive coil of this linear motor is controlled by the main control unit 28.
[0049] On the wafer stages WS [WS1 and] 2, Wafer W is held by vacuum adsorption etc. through the non-illustrated wafer holder, respectively. Moreover, on these wafer stages WS [WS1 and] 2, the reference mark plates FM1 and FM2 with which the front face becomes the same height as the front face of Wafer W are being fixed, respectively. As shown in the top view of drawing 2 , the mark WM for measuring under the wafer alignment microscope WA later mentioned in that longitudinal direction center section is formed in the front face of one reference mark plate FM 1, and the mark RM of the pair used for relative location measurement with Reticle R through projection optics PL at the longitudinal direction both sides of this mark WM is formed in it. The completely same marks WM and RM also as this are formed also on the reference mark plate FM 2 of another side.
[0050] Furthermore, with this operation gestalt, the alignment microscope WA of the off-axis method as an alignment system which detects the mark for location detection (alignment mark) which was formed in the direction of about 45 degrees at predetermined distance, and was formed in the location distant 3000mm from projection optics PL to XY shaft at Wafer W is formed. The level difference is made to Wafer W by exposure to a front layer, and process processing, the mark for location detection for measuring the location of each shot field on a wafer (alignment mark) is also included in it, and this alignment mark is measured under the alignment microscope WA.
[0051] As an alignment microscope WA, the so-called alignment microscope of the FIA (field Image Alignment) system of an image-processing method is used here. According to this, after the illumination light emitted from the light source which is not illustrated [which emits broadband illumination light, such as a halogen lamp,] passes a non-illustrated objective lens, it irradiates on Wafer W (or the reference mark plate FM). The reflected light from the wafer mark field which is not illustrated [of the wafer W front face] carries out the sequential transparency of an objective lens and the non-illustrated index plate, and image formation of the image of a wafer mark and the image of the index on an index plate is carried out on image pick-up sides, such as non-illustrated CCD. The photo-electric-conversion signal of these images is processed by the digital disposal circuit which is not illustrated in the signal-processing unit 16, the relative position of a wafer mark and an index is computed by the non-illustrated arithmetic circuit, and this relative position is told to a main control unit 28. In a main control unit 28, the location of the alignment mark on Wafer W is computed based on this relative position and the measurement value of interferometer systems 26.
[0052] moreover, in the side face by the side of the X shaft orientations 1 of the alignment microscope WA (left-hand side in drawing 1) X fixed mirror 18X used as the criteria of X shaft-orientations location management at the time of alignment actuation of the wafer stages WS1 and WS2 is fixed. Y

fixed mirror 18Y used as the criteria of Y shaft-orientations location management at the time of exposure actuation of the wafer stages WS1 and WS2 is being similarly fixed to the side face by the side of the Y shaft orientations 1 of the alignment microscope WA (space back side in drawing 1).

[0053] In addition, as an alignment microscope, it is not only a FIA system but LIA (Laser Interferometric Alignment). Other optical alignment systems, such as a system and a LSA (Laser Step Alignment) system, of course Other optical equipments, such as a phase-contrast microscope and a differential interference microscope, STM (Scanning Tunnel Microscope: scanning tunneling microscope) which detects the irregularity of the atomic level on the front face of a sample using the tunnel effect, and the force between atoms (attraction and repulsive force) are used. It is also possible to use non-optical equipments, such as AFM (Atomic Force Microscope: atomic force microscope) which detects the irregularity of the atomic molecule level on the front face of a sample, etc.

[0054] Furthermore, in the projection aligner 100 of this operation gestalt, the reticle alignment microscopes 52A and 52B as a mark location detection means for observing the image of reference mark RM on the reference mark plate FM through projection optics PL and the reticle alignment mark on Reticle R (illustration abbreviation) to coincidence are formed above Reticle R. The detecting signals S1 and S2 of the reticle alignment microscopes 52A and 52B are supplied to a main control unit 28. In this case, unitization of the deviation mirrors 54A and 54B for leading the detection light from Reticle R to the reticle alignment microscopes 52A and 52B, respectively is carried out to each reticle alignment microscopes 52A and 52B concerned in one, and the microscope units 56A and 56B of a pair are constituted. Initiation of an exposure sequence evacuates these microscope units 56A and 56B to the location which is not applied to a reticle pattern side with the mirror driving gear which is not illustrated by the command from a main control unit 28.

[0055] Next, the interferometer systems 26 of drawing 1 which manages the location of the wafer stages WS1 and WS2 are explained in full detail.

[0056] As shown in drawing 3 , in fact these interferometer systems 26 1st laser interferometer 26Xe for X shaft-orientations location measurement, Although constituted including 2nd [for Y shaft-orientations location measurement] laser interferometer 26Ye, 3rd laser interferometer 26Xa for X shaft-orientations location measurement, and 4th laser interferometer 26Ya for Y shaft-orientations location measurement, in drawing 1 , these are typically illustrated as interferometer systems 26.

[0057] While 1st laser interferometer 26Xe projects the reference beam Xe 1 of X shaft orientations which pass along the projection core of projection optics PL to X fixed mirror 14X The length measurement beam Xe 2 is projected to the reflector of a wafer stage (WS1 or WS2), and the variation rate of the wafer stage reflector over fixed mirror 14X is measured based on the interference condition that the reflected light of these two beams was made to pile up and interfere in one.

[0058] Moreover, while 2nd laser interferometer 26Ye projects the reference beam Ye1 of Y shaft orientations which pass along the projection core of projection optics PL to Y fixed mirror 14Y The length measurement beam Ye2 is projected to the reflector of a wafer stage (WS1 or WS2), and the variation rate of the wafer stage reflector over fixed mirror 14Y is measured based on the interference condition that the reflected light of these two beams was made to pile up and interfere in one.

[0059] Moreover, while 3rd laser interferometer 26Xa projects the reference beam Xa1 of X shaft orientations which pass along the detection core of the alignment microscope WA to X fixed mirror 18X The length measurement beam Xa2 is projected to the reflector of a wafer stage (WS1 or WS2), and the variation rate of the wafer stage reflector over fixed mirror 18X is measured based on the interference condition that the reflected light of these two beams was made to pile up and interfere in one.

[0060] Moreover, while 4th laser interferometer 26Ya projects the reference beam Ya1 of Y shaft orientations which pass along the detection core of the alignment microscope WA to Y fixed mirror 18Y The length measurement beam Ya2 is projected to the reflector of a wafer stage (WS1 or WS2), and the variation rate of the wafer stage reflector over fixed mirror 18Y is measured based on the interference condition that the reflected light of these two beams was made to pile up and interfere in one.

[0061] The length measurement shaft of 1st laser interferometer 26Xe which consists of the reference beam Xe 1 and the length measurement beam Xe 2 here The 1st length measurement shaft Xe The 2nd

length measurement shaft of laser interferometer 26Ye which consists of the reference beam Ye1 and the length measurement beam Ye2 The 2nd length measurement shaft Ye, The 3rd length measurement shaft of laser interferometer 26Xa which consists of the reference beam Xa1 and the length measurement beam Xa2 The 3rd length measurement shaft Xa, When the 4th length measurement shaft of laser interferometer 26Ya which consists of the reference beam Ya1 and the length measurement beam Ya2 shall be called the 4th length measurement shaft Ya, the 1st length measurement shaft Xe and the 2nd length measurement shaft Ye Focusing on projection of projection optics PL (an optical-axis Ae core and coincidence), it crosses perpendicularly, and the 3rd length measurement shaft Xa and the 4th length measurement shaft Ya cross perpendicularly focusing on detection of the alignment microscope WA. The location of a wafer stage can be correctly measured by each measurement shaft orientations, without influencing this of the Abbe error by yawing of a wafer stage etc. at the time of measurement of the mark for location detection on Wafer W (alignment mark), and exposure of the pattern to Wafer W top so that it may mention later. In addition, it is much more desirable as the above 1st thru/or the 4th laser interferometer to use the heterodyne interferometer of two frequencies in order to raise the accuracy of measurement.

[0062] The measurement value of return and interferometer systems 26 is supplied to drawing 1 at a main control unit 28, and in a main control unit 28, position control of the wafer stages WS1 and WS2 is carried out through the linear motor mentioned above, carrying out the monitor of the measurement value of these interferometer systems 26.

[0063] While exposure of the reticle pattern which minded projection optics PL to the wafer W on the wafer stages [WS / WS and / 2] 1 is performed in the case of the operation gestalt of **** 1 so that clearly also from drawing 3 The location of a wafer stage is managed by the 1st, 2nd laser interferometer 26Xe, and 26Ye. While measurement of the mark for location detection on Wafer W (alignment mark) is performed by the alignment microscope WA, the location of a wafer stage is managed by 3rd and 4th laser interferometer 26Xa and 26Ya. However, since each length measurement shaft stops hitting the reflector of each wafer stage after exposure is completed, or after measurement of an alignment mark is completed, location management of the wafer stage by interferometer systems 26 becomes difficult.

[0064] for this reason, in the projection aligner 100 of this operation gestalt The 3rd location shown by the imaginary line in drawing 3 in the wafer stage WS 1, and the 2nd location shown as a continuous line in drawing 3 , The 1st robot arm 20 as a migration means to which it is made to move free among 3 points with the 1st location in which the wafer stage WS 2 is located in drawing 3 , The 2nd robot arm 22 as a migration means to which the wafer stage WS 2 is similarly moved free among 3 points of the 1st location of the above, the 2nd location, and the 3rd location is formed. These [1st] and the 2nd robot arm 20 and 22 are also controlled by the main control unit 28, and the position control precision of the wafer stage of these [1st] and the 2nd robot arm 20 and 22 has become about **1 micrometer in general. In order to realize the above-mentioned position control precision certainly, it combines a vertical-movement pin as shown with Signs 24A and 24B in drawing 3 as a stopper, and you may make it prepare it, although detailed explanation is omitted since the owner articulated robot arm of a well-known configuration is used as these robot arms 20 and 22.

[0065] When the 3rd location, the 2nd location, and the 1st location are explained briefly, here with the 3rd location The wafer exchange location in which delivery of Wafer W is performed between the conveyance arms 50 and wafer stages (WS1, WS2) which constitute a part of external substrate conveyance device is meant. The 2nd location After loading of Wafer W is completed, the location of arbitration where it is the location where alignment is performed to the wafer W on a wafer stage, and both the 3rd length measurement shaft Xa and the 4th length measurement shaft Ya hit the reflector of a wafer stage is meant. The 1st location means the location of arbitration where it is the location where exposure is performed to the wafer W on a wafer stage, and both the 1st length measurement shaft Xe and the 2nd length measurement shaft Ye hit the reflector of a wafer stage, after the alignment of a wafer is completed.

[0066] As mentioned above, with this operation gestalt, the location shown in drawing 3 shall be defined as the 1st location, the 2nd location, and the 3rd location, respectively, but the 2nd location is good also

considering the location where what kind of location may be defined, for example, the mark WM on the reference mark plate FM becomes in the detection field of the alignment microscope WA as the 2nd location, if the above-mentioned definition satisfies. Similarly, the 1st location is also good also considering the location where what kind of location may be defined, for example, the mark RM on the reference mark plate FM becomes in the projection field of projection optics PL as the 1st location, if the above-mentioned definition is satisfied.
[0067] Next, the flow of overall actuation of the projection aligner 100 of this operation gestalt constituted as mentioned above is explained.
[0068] ** As a premise, the wafer stage WS 1 shall be located in the 3rd location, and the wafer stage WS 2 shall be located in the 1st location.
[0069] First, wafer exchange is performed between the wafer stage WS 1 and the conveyance arm 50. detailed, since this wafer exchange is performed by the pin center,large rise on the wafer stage WS 1 (wafer rise device), and the conveyance arm 50 as usual here -- it explains -- although it ******, since the positioning accuracy of a robot arm is **1 or less um in general as stated previously, also let positioning accuracy of the conveyance arm 50 be a thing almost comparable as this. In advance of this wafer exchange, outline positioning is made in X, Y, and the direction of theta by non-illustrated PURIARAIMENTO equipment, and, as for Wafer W, the load location to a wafer stage top does not shift greatly, for example, the load location of the wafer W to the reference mark plate FM 1 has also become in the error range of **1 or less above um.
[0070] During this wafer exchange, although the location is not managed with a laser interferometer, since the 1st robot arm 20 has caught the wafer stage WS 1, the wafer stage WS 1 does not produce un-arranging [of going to the place where the wafer stage WS 1 is selfish]. In addition, while being caught by the 1st robot arm 20, the linear motor which drives the wafer stage WS 1 shall have stopped (it is the same as below).
[0071] After wafer exchange (loading of the wafer W to the wafer stage WS 1 top) is completed, in a main control unit 28, the 1st robot arm 20 is controlled, the wafer stage WS 1 is moved to the 2nd location shown as a continuous line in drawing 3 , and 3rd and 4th laser interferometer 26Xa and 26Ya are reset to coincidence in this location. since the 1st robot arm 20 finishes a duty here after this reset is completed -- this -- the 1st robot arm 20 shunts in the location which leaves the wafer stage WS 1 by the non-illustrated drive system according to the directions from a main control unit 28, and does not become obstructive.
[0072] With a main control unit 28, position control is carried out through the linear motor which mentioned the wafer stage WS 1 above so that the mark WM on the reference mark plate FM 1 on the wafer stage WS 1 might be positioned in the detection field of the alignment microscope WA after above 3rd and 4th laser interferometer 26Xa and reset termination of 26Ya, carrying out the monitor of the measurement value of interferometer 26Xa and 26Ya. The positioning accuracy to the 2nd location by the 1st robot arm 20 here Since **1 or less um is possible in general and the interferometer length measurement shaft is reset like the above-mentioned in this 2nd location Based on a design value (relative-position relation on a design with the reflector of the wafer stage WS 1, and the mark WM on a reference mark plate), position control is possible at the resolving power of about 0.01 micrometers after that. As a result, the wafer stage WS 1 is positioned in precision sufficient for the mark WM measurement under the alignment microscope WA. In addition, when the mark WM on the reference mark plate FM 1 on the wafer stage WS 1 sets the 2nd location as the location positioned in the detection field of the alignment microscope WA, since migration of the wafer stage WS 1 after the above-mentioned interferometer reset is unnecessary, it is much more desirable in respect of a throughput.
[0073] Next, under the alignment microscope WA, the location (deltaWX and deltaWY) of the mark WM on the reference mark plate FM 1 on the basis of the detection core (index core) of this alignment microscope WA is measured, and the average (X0 and Y0) of 3rd [under this measurement] and 4th laser interferometer 26Xa and the measurement value of 26Ya is calculated in a main control unit 28. When the measurement value of laser interferometer 26Xa and 26Ya shows (X0-deltaWX and Y0-

deltaWY) by this, it turns out that the mark WM on the reference mark plate FM 1 is just under the detection core (index core) of the alignment microscope WA. A series of actuation after above 3rd and 4th laser interferometer 26Xa and reset of 26Ya shall be called W-SET to below.
[0074] Thus, while wafer exchange, interferometer reset, and a series of actuation of W-SET are performed on one wafer stage WS 1, the following actuation is performed on the wafer stage WS 2 of another side.
[0075] That is, the wafer stage WS 2 is moved to the 1st location by the 2nd robot arm 22 like the above-mentioned, and point-to-point control to this 1st location is also performed in the precision of **1 or less um. In a main control unit 28, the 1st, 2nd laser interferometer 26Xe, and 26Ye are reset at the same time migration of the wafer stage WS 2 in this 1st location is completed.
[0076] since the 2nd robot arm 22 finishes a duty here after reset of this 1st [the], 2nd laser interferometer 26Xe, and 26Ye is completed -- this -- the 2nd robot arm shunts in the location which leaves the wafer stage WS 2 by the non-illustrated drive system according to the directions from a main control unit 28, and does not become obstructive.
[0077] Next, the location of the wafer stage WS 2 is controlled by the main control unit 28 through a linear motor to be positioned in the location where the mark RM on the reference mark plate FM 2 laps with the reticle alignment mark (illustration abbreviation) currently formed in Reticle R through projection optics in the projection field of projection optics PL, carrying out the monitor of the measurement value of laser interferometer 26Xe and 26Ye. In this case, the positioning accuracy to the 1st location by the 2nd robot arm 22 Since **1 or less um is possible in general and the interferometer length measurement shaft is reset like the above-mentioned in this 1st location Based on a design value (relative-position relation on a design with the reflector of the wafer stage WS 2, and the mark RM on the reference mark plate FM 2), position control is possible at the resolving power of about 0.01 micrometers after that. As a result, the wafer stage WS 2 is positioned under the reticle alignment microscopes 52A and 52B in sufficient precision required to observe a reticle alignment mark and the mark RM on the reference mark plate FM to coincidence.
[0078] Under the reticle alignment microscopes 52A and 52B, next, relative spacing of the reticle alignment mark on Reticle R, and the mark RM on the reference mark plate FM 2 (delta RX, delta RY), Namely, the location gap (deltaRX and deltaRY) with the reference mark RM core which is an origin/datum on the wafer stage WS 2 to the projection core of the pattern image of the reticle R as a predetermined origin/datum in the projection field of projection optics PL is measured. In a main control unit 28, the measurement value (X1 and Y1) of laser interferometer 26Xe at that time and 26Ye is read at the same time it incorporates the measurement value of these reticle alignment microscopes 52A and 52B. Thereby, it turns out that the location where the measurement value of laser interferometer 26Xe and 26Ye serves as (X1-deltaRX, Y1-deltaRY) is a location with which a reticle alignment mark and the mark RM on the reference mark plate FM 2 lap through projection optics PL exactly. A series of actuation after reset of the above 1st, 2nd laser interferometer 26Xe, and 26Ye shall be called R-SET to below.
[0079] ** Next, wafer alignment by the side of the wafer stage WS 1 and exposure by the side of the wafer stage WS 2 are performed in parallel.
[0080] Namely, after 3rd [which was mentioned above] and 4th laser interferometer 26Xa and reset of 26Ya The location of the wafer stage WS 1 is managed based on the measurement value of laser interferometer 26Xa and 26Ya. Measurement of the mark (alignment mark) location for location detection of the specific sample shot beforehand defined among two or more shot fields on Wafer W in the main control unit 28 Sequential migration of the wafer stage WS 1 is carried out through a linear motor, carrying out the monitor of the measurement value of interferometer 26Ya and 26Xa, and it carries out on system of coordinates (Xa, Ya) based on the output of the alignment microscope WA. In this case, since the measurement value (X0-deltaX and Y0-deltaY) of an interferometer in case the mark WM on the reference mark plate FM 1 comes just under the detection core of the alignment microscope WA can be found, In order to position each alignment mark on Wafer W in the detection field of the wafer alignment microscope WA based on this value and the design value of the relative position of a

reference mark WA and each alignment mark, laser interferometer 26Ya, It is called for by the operation whether the measurement value of 26Xa(s) should just move the wafer stage WS 1 to the location which shows which value, and sequential migration of the wafer stage WS 1 is carried out based on this result of an operation.

[0081] Although it is sufficient for the alignment of X, Y, and theta of Wafer W if two X measurement marks and one Y measurement mark (or one X measurement mark and two Y measurement marks) are measured also at the lowest, measurement of three or more X measurement marks which are not on a straight line, and three or more Y measurement marks which are not on a straight line shall be performed as an EGA sample shot here.

[0082] And the statistics operation by least square method which is indicated by JP,61-44429,A etc. is performed using the alignment mark (wafer mark) location of each of this measured sample shot, and the array data of the shot field on a design, and it asks for all the array data of the above-mentioned two or more shot field on Wafer W. However, as for a count result, it is desirable to take the value (X0-deltaX and Y0-deltaY) and difference of an interferometer when the mark WM on the reference mark plate FM 1 for which it asked previously comes directly under the detection core of the alignment microscope WA, and to change into the data on the basis of the reference mark WA on the reference mark plate FM 1. Thereby, the relative physical relationship of the mark WM on the reference mark plate FM 1 and the reference point of each shot field on Wafer W makes it the need, and is fully known.

[0083] Thus, in parallel to fine alignment (EGA) being performed by the wafer stage WS 1 side, superposition exposure with the pattern image of Reticle R and the established pattern of the shot field on Wafer W is performed as follows by the wafer stage WS 2 side.

[0084] Namely, the measurement result of the location gap error above-mentioned in a main control unit 28 and the coordinate location of the wafer stage WS 2 at that time (Xe, Ye), It is based on the array coordinate data of each shot on the basis of the reference mark WA on the reference mark plate FM 2 currently beforehand computed like the above by alignment actuation. Sequential exposure of the reticle pattern is carried out on Wafer W by the step-and-repeat method, carrying out closing motion control of the shutter in an illumination-light study system positioning each shot field on Wafer W in an exposure location carrying out the monitor of the measurement value of interferometer 26Ye and 26Xe. The exposure to the wafer W on the wafer stage WS 2 is preceded here. In spite of having reset interferometer 26Xe and 26Ye (the length measurement shaft of an interferometer having once run out) When the reason in which highly precise superposition is possible is explained in full detail, spacing of the mark WM on the reference mark plate FM 2 and Mark RM is known. The relative physical relationship of the mark WM on the reference mark plate FM 2 and the reference point of each shot field on Wafer W is computed like the above-mentioned by the fine alignment (EGA) performed in advance of this. [where / on Reticle R / the reticle alignment mark on Reticle R exists, and] Since (namely, relative-position relation with the mark RM which are the projection core (it is mostly in agreement with the projection core of projection optics PL) of the pattern image of the reticle which is a predetermined origin/datum in the projection field of projection optics PL, and an origin/datum on the wafer stage WS 2) is measured, it is based on these measurement results. It is because it is clear whether wafer W top each shot field laps with the pattern image of Reticle R exactly if the measurement value of the 1st, 2nd laser interferometer 26Xe, and 26Ye turns into which value.

[0085] ** After fine alignment (EGA) is completed by the wafer stage WS 1 side as mentioned above and the exposure of a reticle pattern to all the shot fields on Wafer W is completed by the wafer stage WS 2 side, move the wafer stage WS 1 to the 1st location of the lower part of projection optics PL, and move the wafer stage WS 2 to the 3rd location which is a wafer exchange location.

[0086] That is, the wafer stage WS 1 is caught by the 1st robot arm 20 according to the directions from a main control unit 28, and is moved to the 1st location. Point-to-point control to this 1st location is also performed in the precision of **1 or less um. In a main control unit 28, the 1st, 2nd laser interferometer 26Xe, and 26Ye are reset at the same time migration of the wafer stage WS 1 in this 1st location is completed.

[0087] since the 1st robot arm 20 finishes a duty here after this reset is completed -- this -- the 1st robot

arm 20 shunts in the location which leaves the wafer stage WS 1 by the non-illustrated drive system according to the directions from a main control unit 28, and does not become obstructive.
[0088] Next, in a main control unit 28, R-SET is performed like the wafer stage WS 2 side described previously. By this Relative spacing of a reticle alignment mark and the mark RM on the reference mark plate FM 1 (deltaRX and deltaRY), namely, as a predetermined reference point in the projection field of projection optics PL The stage coordinate location (X1 and Y1) at the time of the location gap (deltaRX and deltaRY) with the reference mark RM core which is a reference point on the wafer stage WS 2 to the projection core of the pattern image of the ** reticle R, and this location gap measurement is measured.
[0089] While interferometer reset and R-SET are performed as mentioned above by the wafer stage WS 1 side According to the directions from a main control unit 28, the 2nd robot arm 22 catches the wafer stage WS 2 which exposure actuation ended. The wafer stage WS 2 is moved to a wafer delivery location (the 3rd location) for wafer exchange, and wafer exchange, interferometer reset, and W-SET are performed like the wafer stage WS 1 side mentioned above after that.
[0090] ** Subsequently, like the above-mentioned, in parallel to sequential exposure of the reticle pattern being carried out on Wafer W by the step-and-repeat method by the wafer stage WS 1 side, control actuation of both stages by the main control unit 28 so that fine alignment (EGA) is performed by the wafer stage WS 2 side.
[0091] ** Actuation of the actuation [of both the stages WS1 and WS2], 1st, and 2nd robot arm is controlled by the main control unit 28 so that actuation of ** explained until now - ** is repeated successively after that.
[0092] The flow of carrying-out on both [which was explained above] stages WS [WS1 and] 2 parallel operation is shown in <u>drawing 4</u> .
[0093] Since exposure actuation by the side of one stage of the wafer stage WS 1 and the wafer stages WS 2 and fine alignment actuation by the side of the stage of another side can be performed in parallel according to the projection aligner 100 concerning the operation gestalt of **** 1 as explained above, compared with wafer exchange (search alignment is included), fine alignment, and the conventional technique in which exposure was performed sequentially, the large improvement in a throughput is expectable. Usually, in an exposure processing sequence, it is because the rate of the time amount which fine alignment actuation and exposure actuation take is large.
[0094] Since it is premised on the length measurement shaft of interferometer systems 26 going out according to the above-mentioned operation gestalt, moreover, the die length of the reflector (when using a migration mirror, it is this migration mirror) of each wafer stage It comes out enough with extent slightly longer than a wafer diameter, and from a certain thing, compared with the conventional technique on condition of a length measurement shaft not going out, small and lightweight-izing of a wafer stage are possible, and, thereby, improvement in stage controllability ability is expected.
[0095] Furthermore, since the mark location on the reference mark plate FM on a stage is measured in each exposure forward before alignment with the above-mentioned operation gestalt on the assumption that the length measurement shaft of interferometer systems goes out However long the projection core of projection optics PL and the pitch (the amount of base lines) based on [of the alignment microscope WA] detection may become, especially un-arranging does not have it, and it somewhat fully detaches spacing of projection optics PL and the alignment microscope WA. Wafer alignment and exposure can be performed in parallel in time, without the wafer stage WS 1 and the wafer stage WS 2 producing interference etc.
[0096] Moreover, with the above-mentioned operation gestalt, since interferometer systems 26 are equipped with the 1st length measurement shaft Xe which crosses perpendicularly focusing on projection of projection optics PL, the 2nd length measurement shaft Ye, and the 3rd length measurement shaft Xa and the 4th length measurement shaft Ya which crosses perpendicularly focusing on detection of the alignment microscope WA, the two-dimensional location of a wafer stage is correctly manageable at the time of any at the time of alignment actuation and exposure.
[0097] In addition, since the fixed mirrors 14X, 14Y, 18X, and 18Y for interferometers were fixed to the

side face of projection optics PL, and the side face of the alignment microscope WA, as long as there is no fluctuation of a fixed mirror location during alignment measurement and exposure, even if it changes a fixed mirror location by a change with time, vibration of equipment, etc., un-arranging [of the position control precision of a wafer stage falling by this fluctuation] will not arise. Even if it follows, for example, makes the alignment microscope WA the configuration which can move up and down, it does not produce any un-arranging, either.

[0098] In addition, although the operation gestalt of the above 1st explained the case where the wafer stage WS 1 and the wafer stage WS 2 were moved among 3 points of the 1st location, the 2nd location, and the 3rd location, by the 1st and 2nd robot arm 20 and 22 When this invention does not make it limit to this and is [for example,] made to perform wafer exchange in the 2nd location, you may make it move the wafer stage WS 1 and the wafer stage WS 2 between the 1st location and the 2nd location by the 1st and 2nd robot arm 20 and 22. In this case, after controlling actuation of both stages by the main control unit 28 so that exposure actuation of the wafer W on one stage of the wafer stage WS 1 and the wafer stages WS 2 and alignment actuation of the wafer W on the stage of another side are performed in parallel, the location of both stages will be replaced by the 1st and 2nd robot arm 20 and 22.

[0099] Moreover, although the operation gestalt of the above 1st explained the case where exposure of a step-and-repeat method was performed to the wafer W on a stage based on EGA measurement, projection exposure of the pattern image of a reticle may be carried out one by one to each shot field on Wafer W, repeating alignment and exposure not only with this but with a die Bayh die. Since the relative position of each alignment mark to the mark WM formed in the reference mark plate FM on a stage at the time of alignment is measured even if it is this case, based on this relative position, a reticle pattern image can be laid on top of each shot field like the above. As for this die Bayh die method, it is desirable to adopt, when there are few shot fields on Wafer W. It is more desirable to be based on EGA considered and mentioned above from a viewpoint which prevents the fall of a throughput, when there are many shot fields.

[0100] With the operation gestalt of the above 1st, the 1st robot arm 20 one stage WS 1 Moreover, the 1st location, Although the case where made it move among 3 points of the 2nd location and the 3rd location, and the 2nd robot arm 22 moved the stage WS 2 of another side among 3 points of the 1st location, the 2nd location, and the 3rd location was explained As this invention is not limited to this, for example, one robot arm 20 carries a stage WS 1 (or WS2) from the 1st location to the 3rd location, the 1st location, When it carries and releases to the location which is other than the 2nd location and the 3rd location and the robot arm 22 of another side adopts the method of moving this stage WS 1 (or WS2) from this location to the 3rd location It is also possible to make one robot arm 20 only into for [of the 2nd location of both stages and the 1st location] conveyances, and to make the robot arm 2 of another side only into for [of the 3rd location of both stages and the 2nd location] conveyances.

[0101] Moreover, you may make it measure X of a wafer stage, and not only the advancing-side-by-side location of Y but yawing and pitching, using the interferometer of a multiple spindle as each laser interferometer which constitutes interferometer systems 26.

[0102] << -- 2nd operation gestalt>> -- next, the 2nd operation gestalt of this invention is explained based on drawing 5 . Here, about a component the same as that of the 1st operation gestalt mentioned above, or equivalent, while using the same sign, the explanation shall be omitted.

[0103] It has the description at the point that this 2nd operation gestalt is constituted disengageable by two parts with substrate attachment component WS1b of the same configuration with the wafer stage WS 1 removable on stage body WS1a and this stage body WS1a, and the wafer stage WS 2 is constituted disengageable similarly at two parts of stage body WS2a and substrate attachment component WS2b of the same configuration removable on this stage body WS2a.

[0104] While adsorption maintenance of the wafer W is carried out through the non-illustrated wafer holder at substrate attachment component WS1b and WS2b, the reflector which functions as a migration mirror for interferometers is formed in the side face, respectively. Moreover, the reference mark plates FM1 and FM2 are formed in the top face at such substrate attachment component WS1b and WS2b, respectively.

[0105] Although parallel processing is performed on the wafer stages WS [WS1 and] 2 almost like the 1st gestalt mentioned above with the operation gestalt of **** 2 When alignment actuation is completed by one stage side and exposure actuation is completed by the stage side of another side The 1st and 2nd robot arm 20 and 22 is controlled by the main control unit 28. Are concurrent with being conveyed on stage body WS2a which substrate attachment component WS1b by the side of the stage which alignment actuation ended (or WS2b) has stopped in the 1st location (migration). Substrate attachment component WS2b by the side of the stage which exposure ended (or WS1b) is conveyed on stage body WS1a stopped in the 2nd location, it does in this way, and exchange of substrate attachment component WS1b and WS2b is performed. Since location management of the wafer stages WS1 and WS2 becomes impossible in order that the length measurement shaft of interferometer systems 26 may go out in case it is exchanged in substrate attachment component WS1b and WS2b, the stage stoppers 30a and 30b come out, and both stage body WS1a and WS2a are held in the location in the meantime. In this case, wafer exchange is performed by the non-illustrated conveyance arm in the 2nd location.
[0106] Here so that it may be easily imagined from drawing 5 with the operation gestalt of **** 2 As the 2nd location, the location where the mark WM on the reference mark plate FM becomes in the detection field of the alignment microscope WA as the 1st location The location where the mark RM on the reference mark plate FM becomes in the projection field of projection optics PL is defined, respectively. Therefore, the reset and R-SET, or W-SET of a length measurement shaft of interferometer systems 26 will be performed by the main control unit 28 with migration of a up to [the stage body of substrate attachment component WS1b and WS2b].
[0107] Also according to this 2nd operation gestalt, effectiveness equivalent to the 1st operation gestalt mentioned above can be acquired.
[0108] In addition, although the operation gestalt of the above 2nd explained the case where the 1st and 2nd robot arm 20 and 22 moved a substrate attachment component between the 1st location and the 2nd location You may make it the 1st and 2nd robot arm 20 and 22 move a substrate attachment component among 3 points of the 1st location, the 2nd location, and the 3rd location like the 1st operation gestalt mentioned above. In this case, since wafer exchange can be performed in a place unrelated to projection optics PL and the alignment microscope WA, even if it is the case that the working distance of an alignment microscope WA lower part is narrow, there is no un-arranging -- the alignment microscope WA becomes the failure of wafer exchange -- for example.
[0109] In addition, although the above 1st and the 2nd operation gestalt explained the case where a robot arm and a so-called stage stopper were used, as a cure at the time of the length measurement shaft of interferometer systems 26 once going out The 2-dimensional grating is minced for example, not only on this but on the wafer stage inferior surface of tongue. A location may be read in under a stage run side with an optical encoder. As long as it can hold stopping a means by which a stage can be correctly moved to the location of a degree after the interferometer length measurement shaft has once gone out, or a stage body, by the position, what kind of means may be used.
[0110] Moreover, although the above 1st and the 2nd operation gestalt explained the case where two wafer stages where it moves independently were prepared, three or more wafer stages where it moves independently may be prepared. When three wafer stages are prepared, for example, exposure actuation, alignment actuation, and wafer display flatness measurement actuation can be performed in parallel. Moreover, two or more projection optics PL and alignment microscopes WA may be formed. When there is two or more projection optics, exposure actuation of two kinds of different patterns from alignment actuation can be performed in concurrency, and it is suitable for the so-called double exposure etc.
[0111] Furthermore, although the case where this invention was applied to the projection aligner of a step-and-repeat method was illustrated with the above-mentioned operation gestalt, the applicability of this invention is not limited to this, and, of course in addition to this, this invention can apply the projection aligner of so-called step - and - scanning method to other aligners, such as for example, electron beam direct writing equipment.
[0112]

[Effect of the Invention] As explained above, while being able to raise a throughput according to invention according to claim 1, the outstanding exposure approach which is not in the former that the magnitude of a substrate stage can be defined regardless of the amount of base lines is offered.
[0113] Moreover, according to invention given in claim 2 thru/or 11, it is effective in the ability to raise a throughput by carrying out parallel processing of the exposure actuation on one substrate stage, and the alignment actuation on the stage of another side.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing roughly the whole aligner configuration concerning the 1st operation gestalt.
[Drawing 2] It is the outline top view of one wafer stage of drawing 1 .
[Drawing 3] It is the outline top view of the equipment of drawing 1 .
[Drawing 4] It is drawing showing the flow of the actuation in the equipment of drawing 1 .
[Drawing 5] It is the outline top view showing the configuration of the principal part of an aligner in the 2nd operation gestalt.
[Description of Notations]
14X, 18X X fixed mirror (fixed mirror)
14Y, 18Y Y fixed mirror (fixed mirror)
20 1st Robot Arm (Migration Means)
22 2nd Robot Arm (Migration Means)
26 Interferometer Systems
28 Main Control Unit (Control Means)
50 Conveyance Arm (a Part of Substrate Conveyance Device)
52A, 52B Reticle alignment microscope (mark location detection means)
100 Aligner
WS1a, WS2a Stage body
WS1b, WS2b Substrate attachment component
FM1, FM2 Reference mark plate
WM, RM Reference mark
R Reticle (mask)
W Wafer (induction substrate)
PL Projection optics
WS1 Wafer stage (the 1st substrate stage)
WS2 Wafer stage (the 2nd substrate stage)
WA Alignment microscope (alignment system)
Xe The 1st length measurement shaft
Ye The 2nd length measurement shaft
Xa The 3rd length measurement shaft
Ya The 4th length measurement shaft

[Translation done.]

* NOTICES *

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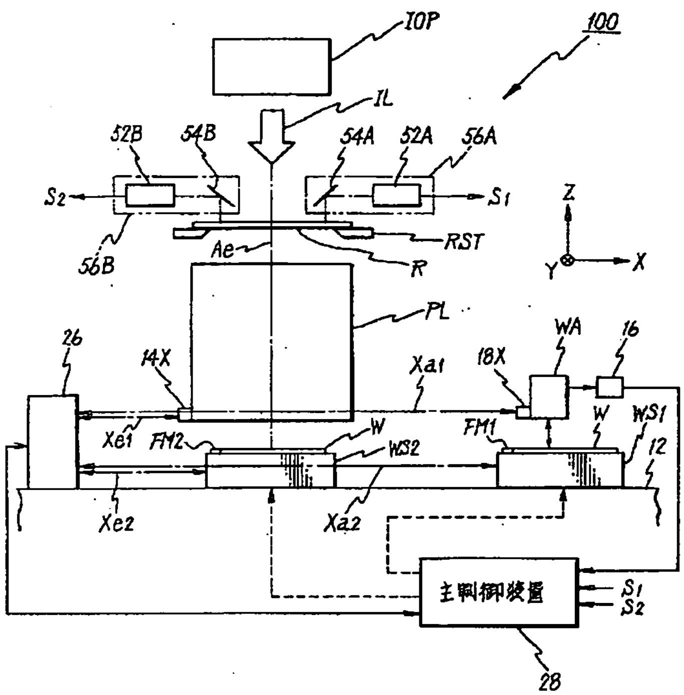
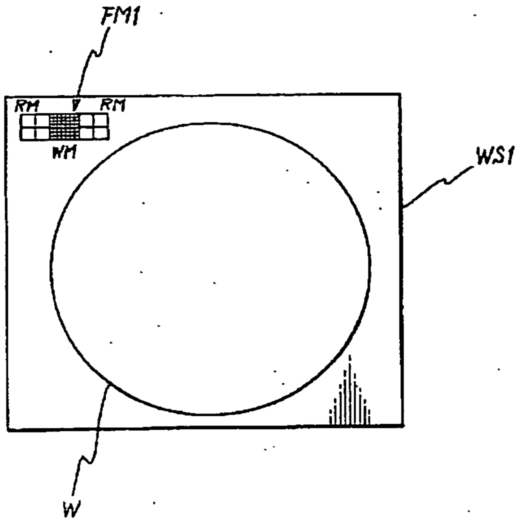
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

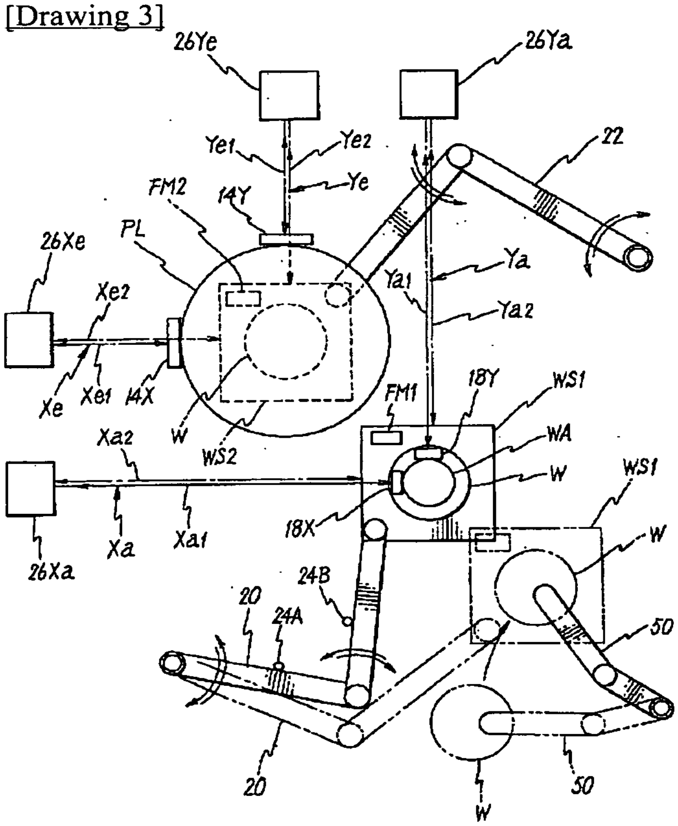
[Drawing 1]



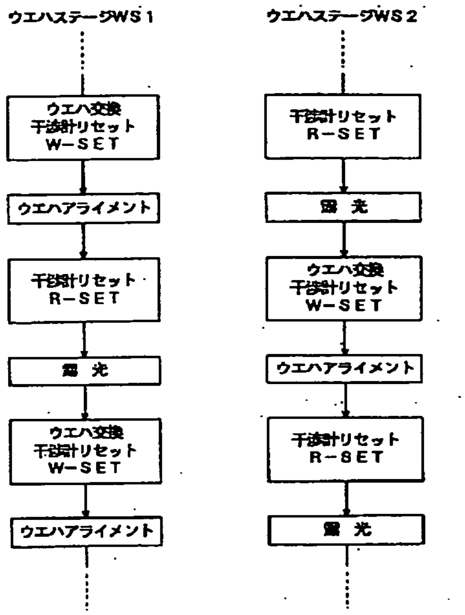
[Drawing 2]



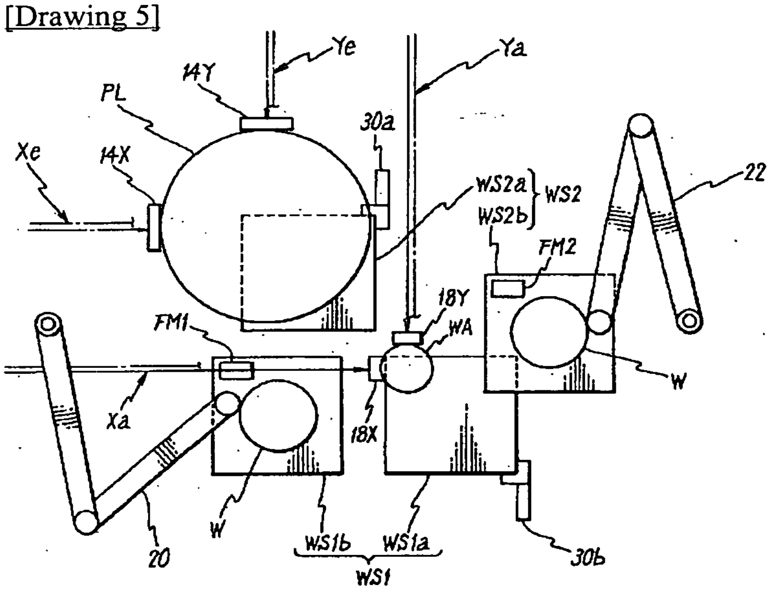
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]

CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
[Section partition] The 2nd partition of the 7th section
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[Application number] Japanese Patent Application No. 8-332846
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H01L 21/027
G03F  7/20
G03F  9/00
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[FI]

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H01L 21/30    516 B
G03F  7/20    521
G03F  9/00        H
H01L 21/30    515 G
H01L 21/30    525 A
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[Procedure revision]
[Filing Date] January 19, Heisei 17 (2005. 1.19)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[The contents of amendment]
[Claim(s)]
[Claim 1]
It is the exposure approach which exposes the image of the pattern formed in the mask on an induction substrate through projection optics,
An induction substrate is held and two independently movable substrate stages are respectively prepared for the inside of the same flat surface,
The pattern image of said mask is exposed through said projection optics on the induction substrate held on one substrate stage of said two substrate stages,
During exposure of the induction substrate held on one [said] substrate stage, the physical relationship of the alignment mark on the induction substrate held on the substrate stage of another side of said two substrate stages and the reference point on the stage of said another side is measured,

Where the reference point on the substrate stage of said another side is positioned in the projection field of said projection optics after exposure termination of the induction substrate held on one [said] substrate stage, the coordinate location of a location gap of the reference point on the substrate stage of said another side to the predetermined reference point in the projection field and the substrate stage of said another side is detected,
The exposure approach characterized by performing alignment of the induction substrate which controlled migration of the substrate stage of said another side based on said detected physical relationship, said detected location gap, and said detected coordinate location, and was held on the stage of said another side, and the pattern image of said mask.
[Claim 2]
It is the aligner which exposes a pattern on an induction substrate through projection optics,
An induction substrate is held and it is the movable 1st substrate stage about the inside of a two-dimensional flat surface.;
Holding an induction substrate, said 1st substrate stage is the independently movable 2nd substrate stage about the inside of the same flat surface as said 1st substrate stage.;
Alignment system for detecting the mark on the induction substrate which was formed apart from said projection optics and held on said substrate stage or on this stage;
Interferometer systems for measuring the two-dimensional location of said 1st substrate stage and the 2nd substrate stage, respectively;
Migration means to which each of said two substrate stages is moved between the 2nd predetermined location in the stage successive range at the time of the alignment to which mark detection on the induction substrate held by the 1st predetermined location and said predetermined alignment system in the stage successive range at the time of the exposure to which exposure is performed through said projection optics to the induction substrate held on this stage on a stage or on this stage is carried out;
While the induction substrate held on one stage of said 1st substrate stage and the 2nd substrate stages is exposed So that mark detection actuation by said alignment system may be performed on the stage of another side of said 1st substrate stage and the 2nd substrate stages The aligner which has the control means which controls said migration means and replaces the location of one [said] substrate stage and the substrate stage of another side after controlling actuation of said two stages, carrying out the monitor of the measurement value of said interferometer systems.
[Claim 3]
Said interferometer systems are equipped with the 1st length measurement shaft and the 2nd length measurement shaft which cross at right angles to mutual focusing on projection of said projection optics, and the 3rd length measurement shaft and the 4th length measurement shaft which cross at right angles to mutual focusing on detection of said alignment system,
Said control means is an aligner according to claim 1 characterized by resetting the length measurement shaft of said interferometer systems in case the location of the stage of said one side and another side is replaced.
[Claim 4]
It is the aligner which exposes a pattern on an induction substrate through projection optics,
An induction substrate is held and it is the movable 1st substrate stage about the inside of a two-dimensional flat surface.;
Holding an induction substrate, said 1st substrate stage is the independently movable 2nd substrate stage about the inside of the same flat surface as said 1st substrate stage.;
Alignment system for detecting the mark on the induction substrate which was formed apart from said projection optics and held on said substrate stage or on this stage;
Interferometer systems for measuring the two-dimensional location of said 1st substrate stage and the 2nd substrate stage, respectively;
The 1st predetermined location in the stage successive range at the time of the exposure to which exposure is performed through said projection optics in each of said two substrate stages to the induction substrate held on the stage, The 2nd predetermined location in the stage successive range at the time of

the alignment to which mark detection on the induction substrate held by said alignment system on a stage or on this stage is carried out, Migration means to which delivery of an induction substrate is carried out between a substrate stage and an external substrate conveyance device, and it is made to move among 3 points of the 3rd location of ****;
The location of one stage of said 1st substrate stage and the 2nd substrate stages is managed by said interferometer systems. While a pattern is exposed through said projection optics by the induction substrate held on one [this] stage Said 1st substrate stage And the alignment actuation which measures the physical relationship of exchange of an induction substrate and the alignment mark on said induction substrate, and the reference point on the stage of said another side based on the detection result of said alignment system and the measurement value of said interferometer systems on the stage of another side of the 2nd substrate stages While controlling said two substrate stages and said migration means to be carried out one by one The aligner which has the control means which controls said two stages and said migration means so that the actuation performed on said two stages may interchange, after both actuation of said two stages is completed.
[Claim 5]
It has further the mask with which the pattern was formed,
The aligner according to claim 4 with which the image of the pattern formed in said mask is characterized by carrying out projection exposure at the induction substrate on said 1st substrate stage and the 2nd substrate stage through projection optics.
[Claim 6]
Said interferometer systems are equipped with the 1st length measurement shaft and the 2nd length measurement shaft which cross at right angles to mutual focusing on projection of said projection optics, and the 3rd length measurement shaft and the 4th length measurement shaft which cross at right angles to mutual focusing on detection of said alignment system,
Said control means is an aligner according to claim 5 characterized by resetting the 1st and 2nd length measurement shaft of said interferometer systems in the case of migration in said 1st location, and resetting the 3rd and 4th length measurement shaft of said interferometer systems about each of said two stages in the case of migration in said 2nd location.
[Claim 7]
The aligner according to claim 6 characterized by having further a mark location detection means to detect the relative-position relation between the projection core of the pattern image of said mask, and the reference point on said stage through said mask and said projection optics.
[Claim 8]
It has the substrate attachment component which said each substrate stage is carried free [attachment and detachment] on a stage body and this body, and holds a substrate, and the reflector for interferometers is established in the side face of this substrate attachment component, and a reference mark is formed in the top face of said substrate attachment component as said reference point,
An aligner given in claim 2 to which said migration means is characterized by moving said substrate attachment component between said every place points instead of said substrate stage thru/or any 1 term of 7.
[Claim 9]
Said migration means is an aligner given in claim 2 characterized by being constituted by the robot arm thru/or any 1 term of 8.
[Claim 10]
An aligner given in claim 2 characterized by attaching in said projection optics and said alignment system the fixed mirror which serves as criteria of length measurement by the interferometer, respectively thru/or any 1 term of 9.
[Claim 11]
It is an aligner given in claim 2 characterized by holding the induction substrate other than said 1st substrate stage and the 2nd substrate stage, and these stages having further at least one another, independently movable substrate stage for the inside of said two same flat surfaces as a substrate stage

thru/or any 1 term of 10.
[Claim 12]
It is the aligner which exposes an induction substrate,
The 1st substrate attachment component which has a reflector for interferometers;
The 2nd substrate attachment component which has a reflector for interferometers;
The 1st stage section possible [in a substrate attachment component] desorption and movable in the direction of two dimension where one substrate attachment component is held;
Where desorption is possible in a substrate attachment component and the substrate attachment component of another side is held, said 1st stage section is the 2nd stage section movable in the direction of two dimension independently.;
The 1st interferometer systems which said 1st stage section was equipped with while, and measure the location of a substrate attachment component using the reflector of the substrate attachment component with which said 1st stage section was equipped;
It has the 2nd interferometer systems and; which measure the location of the substrate attachment component with which said 2nd stage section was equipped using the reflector of the substrate attachment component of another side with which said 2nd stage section was equipped,
Where said 1st stage section is equipped with one [said] substrate attachment component and said 2nd stage section is equipped with the substrate attachment component of said another side in parallel to exposure of the induction substrate held at one [said] substrate attachment component, alignment measurement actuation of the induction substrate held at the substrate attachment component of said another side is performed,
Said exposure in the condition of having equipped said 1st stage section with one [said] substrate attachment component, And after said alignment measurement actuation in the condition of having equipped said 2nd stage section with the substrate attachment component of said another side is completed, said 1st stage section is equipped with the substrate attachment component of said another side with which said 2nd stage section was equipped. The aligner with which exposure of the induction substrate held at the substrate attachment component of said another side is performed.
[Claim 13]
The aligner according to claim 12 with which said 2nd stage section is equipped with one [with which said 1st stage section was equipped / said] substrate attachment component while said 1st stage section is equipped with the substrate attachment component of said another side with which said 2nd stage section was equipped.
[Claim 14]
The aligner according to claim 12 or 13 exchanged between said 1st stage sections and said 2nd stage sections in said 1st substrate attachment component and said 2nd substrate attachment component.
[Claim 15]
An aligner given in any 1 term of claims 12-14 further equipped with the 1st transport device which moves the substrate attachment component of said another side with which said 2nd stage section was equipped to said 1st stage section.
[Claim 16]
The aligner according to claim 15 further equipped with the 2nd transport device which moves one [with which said 1st stage section was equipped / said] substrate attachment component to said 2nd stage section.
[Claim 17]
said 1st stage section -- any of said 1st and 2nd substrate attachment component -- although -- the 1st stopper and; which hold said 1st stage section in a predetermined location when not equipped
said 2nd stage section -- any of said 1st and 2nd substrate attachment component -- although -- an aligner given in any 1 term of claims 12-16 further equipped with the 2nd stopper which holds said 2nd stage section in a predetermined location, and; when not equipped.
[Claim 18]
It has further the projection optics which projects the pattern image of a mask on an induction substrate,

The 1st physical relationship of the shot field on the induction substrate held at the substrate attachment component of said another side and the criteria of the substrate attachment component of said another side is determined by alignment measurement actuation in the condition of having equipped said 2nd stage section with the substrate attachment component of said another side,
After equipping said 1st stage section with the substrate attachment component of said another side, the 2nd physical relationship of the criteria of the substrate attachment component of said another side and the mark of said mask is measured through said projection optics,
An aligner given in any 1 term of claims 12-17 by which alignment of the shot field and said mask on the induction substrate held at the substrate attachment component of said another side with which said 1st stage section was equipped based on said 1st physical relationship and said 2nd physical relationship is carried out one by one, and sequential exposure of the shot field on the induction substrate held at the substrate attachment component of said another side is carried out.
[Claim 19]
The 1st alignment system which detects the alignment mark on said substrate in order to search for said 1st physical relationship;
The aligner according to claim 18 further equipped with the 2nd alignment system which measures said 2nd physical relationship, and;.
[Claim 20]
Said alignment measurement actuation is performed measuring the location of the reflector of the substrate attachment component of said another side with which said 2nd stage section was equipped using said 2nd interferometer systems,
Reset of the length measurement shaft of said 1st interferometer systems which has hit the reflector of the substrate attachment component of said another side with which said 1st stage section was equipped is performed after termination of said alignment measurement actuation,
An aligner given in any 1 term of claims 12-19 by which sequential exposure of the shot field on the induction substrate held at the substrate attachment component of said another side while measuring the location of the reflector of the substrate attachment component of said another side with which said 1st stage section was equipped after said reset using said 1st interferometer systems is carried out.
[Claim 21]
It is the aligner which exposes the image of the pattern formed in the mask on an induction substrate through projection optics,
Base;
It has a reflector for interferometers, an induction substrate is held on said base, and it is the movable 1st substrate stage about the inside of a two-dimensional flat surface.;
It has a reflector for interferometers, an induction substrate is held, and it is the movable 2nd substrate stage about the inside of a two-dimensional flat surface independently of said 1st substrate stage on said base.;
The 1st alignment system which detects the alignment mark on an induction substrate;
The 2nd alignment system which measures the physical relationship of the criteria prepared in said substrate stage, and the mark of said mask through said projection optics;
The 1st interferometer systems from which have a length measurement shaft for measuring the location of the substrate stage holding the induction substrate with which alignment measurement actuation using said 1st alignment system is performed, and this length measurement shaft separates from the reflector of said substrate stage after said alignment measurement actuation termination;
It has a length measurement shaft for measuring the location of the substrate stage holding the induction substrate with which exposure actuation using said projection optics is performed, and has the 2nd interferometer systems and; from which this length measurement shaft separates from the reflector of said substrate stage after said exposure actuation termination,
The 1st physical relationship of the shot field of the induction substrate held on the substrate stage of said another side and the criteria prepared in the substrate stage of said another side is determined by detecting the alignment mark on the induction substrate held on the substrate stage of another side by

said 1st alignment system in parallel to exposure actuation of the induction substrate held on one substrate stage of said two substrate stages,
While the substrate stage of said another side is moved to the predetermined location by the side of the image surface of said projection optics after exposure termination of the induction substrate held on one [said] substrate stage, the 2nd physical relationship of the criteria prepared in the substrate stage of said another side and the mark of said mask is measured using said 2nd alignment system,
The aligner with which sequential exposure of the shot field on the induction substrate currently held on the substrate stage of said another side is carried out based on the location of the substrate stage of said another side measured by said 1st and 2nd physical relationship and said 2nd interferometer systems.
[Claim 22]
It has further a conveyance means to perform exchange actuation of an induction substrate between said substrate stages,
The aligner according to claim 21 with which the alignment mark on the unexposed induction substrate with which the induction substrate after the exposure held on one [said] substrate stage was held on one [said] substrate stage in parallel to exposure of the induction substrate held on the substrate stage of said another side while being exchanged for the unexposed induction substrate using said conveyance means is detected using said 1st alignment system.
[Claim 23]
The aligner according to claim 21 or 22 which includes further a measurement means to measure the location of said substrate stage when both the length measurement shaft of said 1st interferometer systems and the length measurement shaft of said 2nd interferometer systems have run out.
[Claim 24]
Said measurement means is an aligner containing an optical encoder according to claim 23.
[Claim 25]
The device manufacture approach including the lithography process which exposes an induction substrate using the aligner indicated by any 1 term of claims 12-24.
[Procedure amendment 2]
[Document to be Amended] Specification
[Item(s) to be Amended] 0039
[Method of Amendment] Modification
[The contents of amendment]
[0039]
In each above-mentioned invention, although only two, the 1st substrate stage and the 2nd substrate stage, were prepared, like invention according to claim 11, the induction substrate other than said 1st substrate stage (WS1) and the 2nd substrate stage (WS2) may be held, and these stages may prepare further at least one another, independently movable substrate stage for the inside of said two same flat surfaces as a substrate stage.
Moreover, according to another mode of this invention, it is the aligner which exposes an induction substrate (W). Desorption is possible in the 1st substrate attachment component (WS1b) which has a reflector for interferometers, the 2nd substrate attachment component (WS2b) which has a reflector for; interferometers, and; substrate attachment component. Where desorption is possible in the 1st stage section (WS2a) movable in the direction of two dimension, and; substrate attachment component where one substrate attachment component is held, and the substrate attachment component of another side is held The reflector of the substrate attachment component with which the 2nd stage section (WS1a) movable in the direction of two dimension and the; 1st stage section (WS2a) were independently equipped with the 1st stage section (WS2a) is used. The 1st stage section (WS2a) was equipped and the reflector of the substrate attachment component of another side with which the 1st interferometer systems (26Xe, 26Ye) which measure the location of a substrate attachment component and the; 2nd stage section (WS1a) were equipped is used. Where it had the 2nd interferometer systems (26Xa, 26Ya) and; which measure the location of the substrate attachment component with which the 2nd stage section (WS1a) was equipped and the 1st stage section (WS2a) is equipped with one substrate attachment

component (for example, WS2b) In parallel to exposure of the induction substrate held at one substrate attachment component (WS2b), where the 2nd stage section (WS1a) is equipped with the substrate attachment component (WS1b) of another side Alignment measurement actuation of the induction substrate held at the substrate attachment component (WS1b) of another side is performed. Exposure in the condition of having equipped the 1st stage section (WS2a) with one substrate attachment component (WS2b), And after alignment measurement actuation in the condition of having equipped the 2nd stage section (WS1a) with the substrate attachment component (WS1b) of another side is completed The 1st stage section (WS2a) is equipped with the substrate attachment component (WS1b) of another side with which the 2nd stage section (WS1a) was equipped, and the aligner with which exposure of the induction substrate held at the substrate attachment component (WS1b) of another side is performed is offered. According to this, a throughput can be raised by carrying out parallel processing of exposure actuation of one stage section, and the alignment measurement actuation of the stage section of another side.
If it depends like, it will be the aligner which exposes the image of the pattern formed in the mask (R) on an induction substrate (W) through projection optics (PL). moreover, another voice of this invention -- Have a reflector for the base (12) and; interferometers, and hold an induction substrate on the base (12), and have the movable 1st substrate stage (WS1) and a reflector for; interferometers for the inside of a two-dimensional flat surface, and an induction substrate is held. The base (12) In a top The 1st substrate stage Independently of (WS1), the inside of a two-dimensional flat surface Projection optics (PL) is minded for the physical relationship of the movable 2nd substrate stage (WS2), the 1st alignment system (WA) which detects the alignment mark on; induction substrate and the criteria (FM1, FM2) prepared in; substrate stage, and the mark of a mask. It has a length measurement shaft (Xa, Ya) for measuring the location of the substrate stage (WS1 or WS2) holding the induction substrate with which alignment measurement actuation using the 2nd alignment system (56A, 56B) and the; 1st alignment system (WA) to measure is performed. This length measurement shaft (Xa, Ya) The location of the substrate stage (WS1 or WS2) holding the induction substrate with which exposure actuation using the 1st interferometer systems (26Xa, 26Ya) and; projection optics (PL) from which it separates from the reflector of a substrate stage after alignment measurement actuation termination is performed It has a length measurement shaft (Xe, Ye) for measuring. This length measurement shaft (Xe, Ye) It has the 2nd interferometer systems (26Xa, 26Ya) and; from which it separates from the reflector of a substrate stage after exposure actuation termination. Are concurrent with exposure actuation of the induction substrate held on one substrate stage of the two substrate stages (for example, WS2). By detecting the alignment mark on the induction substrate held on the substrate stage (WS1) of another side by the 1st alignment system (WA) The 1st physical relationship of the shot field of the induction substrate held on the substrate stage (WS1) of another side and the criteria (FM1) prepared in the substrate stage (WS1) of another side is determined. While the substrate stage (WS1) of another side is moved to the predetermined location by the side of the image surface of projection optics (PL) after exposure termination of the induction substrate held on one substrate stage (WS2) The 2nd physical relationship of the criteria (FM1) and the mark of a mask (R) which were prepared in the substrate stage (WS1) of another side is measured using the 2nd alignment system (56A, 56B). Based on the 1st and 2nd physical relationship and the location of the substrate stage (WS1) of another side measured by the 2nd interferometer systems (26Xa, 26Ya), the aligner with which sequential exposure of the shot field on the induction substrate currently held on the substrate stage (WS1) of another side is carried out is offered. According to this, a throughput can be raised by carrying out parallel processing of exposure actuation of one substrate stage, and the alignment measurement actuation of the substrate stage of another side.

[Translation done.]